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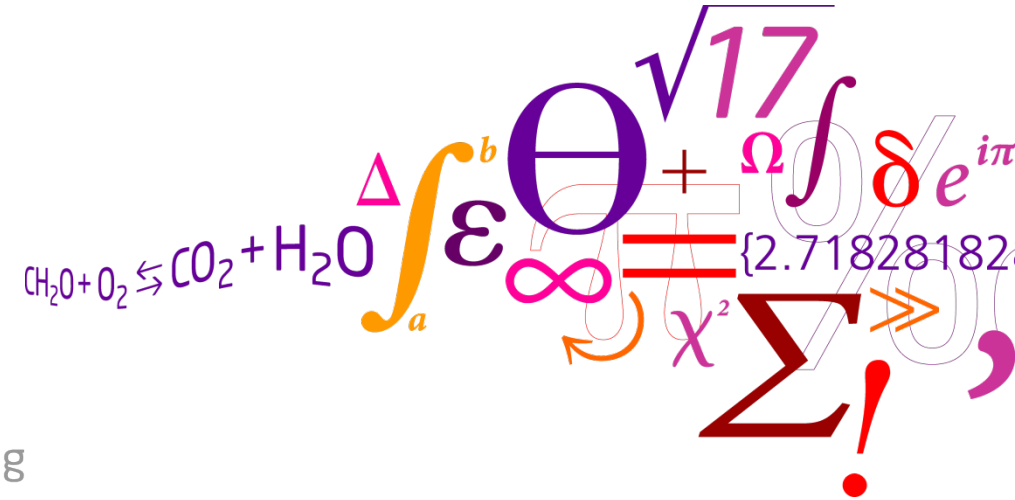
Technical University of Denmark

Aquatic Ecotoxicity Testing of Nanoplastics (and microplastics)

Lessons learned from nanoecotoxicology

Nanna B. Hartmann, Sinja Rist, Anders Baun

SETAC Europe 26th Annual Meeting
22-26 May 2016
Nantes, France



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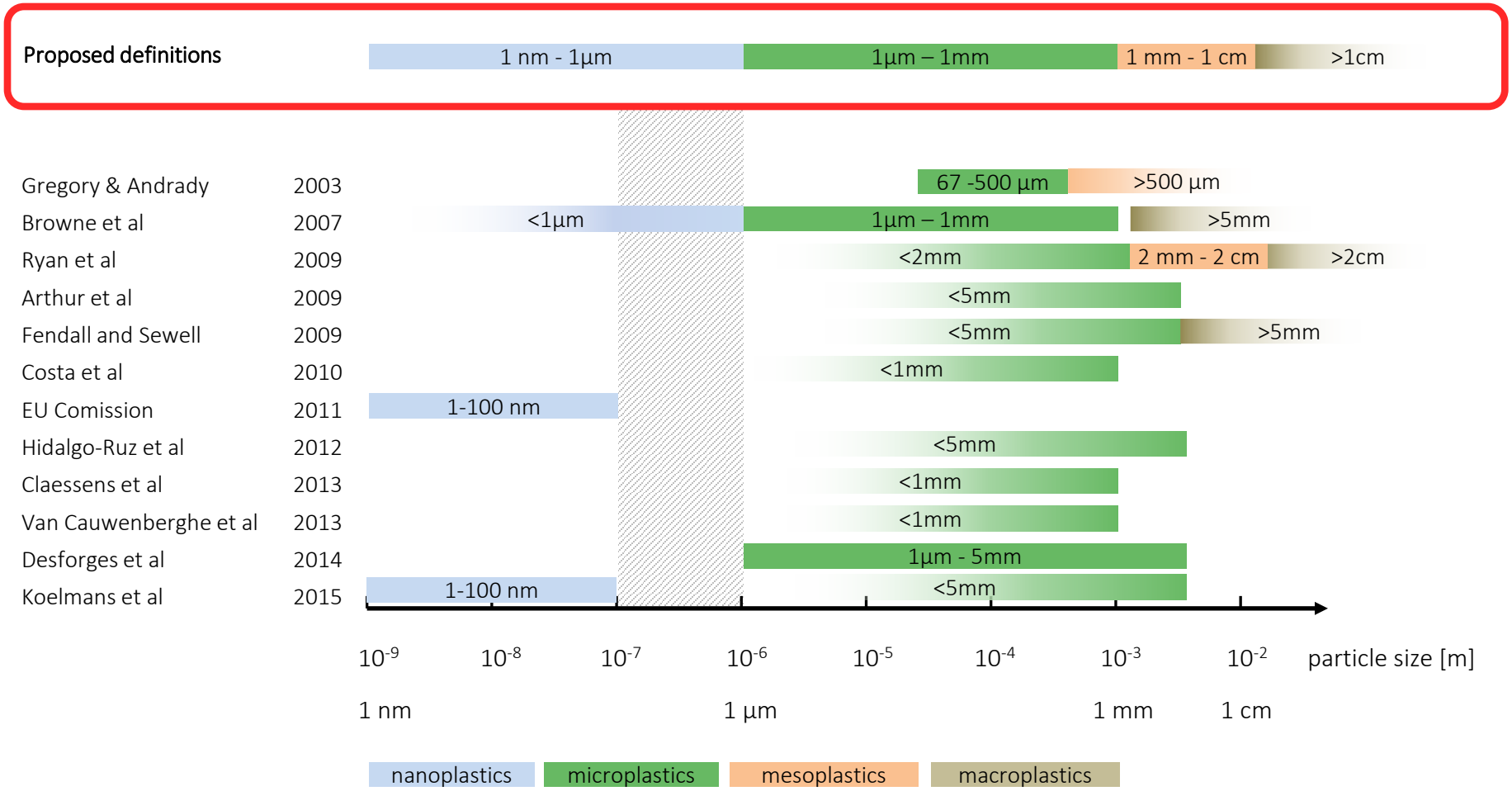
Tuning the test system…

Definition of nanoplastics



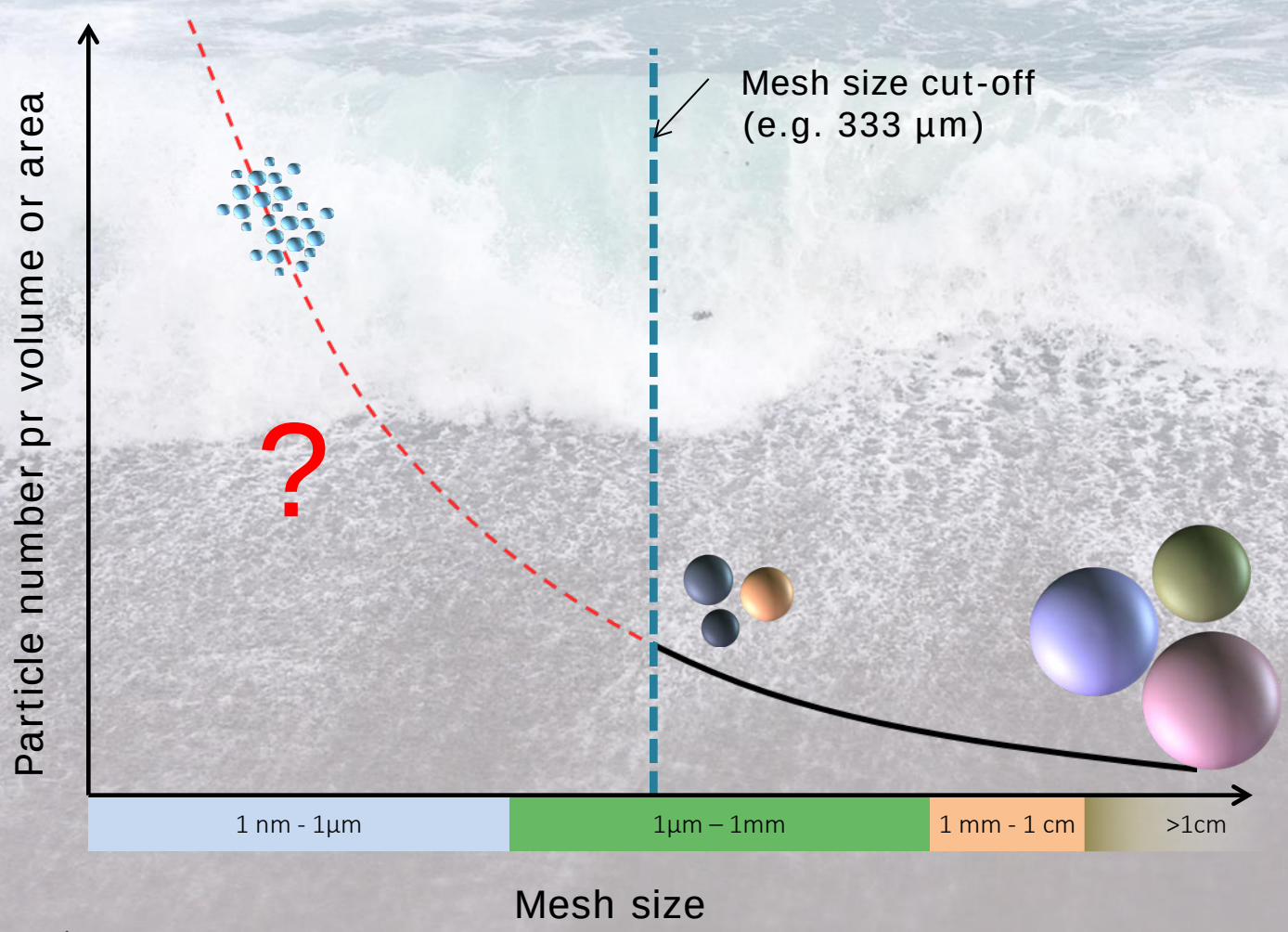
Similarities and differences

	Engineered nanomaterials (ENMs)	Nanoplastics (and microplastics)
Composition	Metal, metal oxide, carbon based, organic…	Synthetic polymers, natural rubber…
Sources to occurrence in the aquatic environment	Mainly primary (intentional production)	Mainly secondary (degradation in the environment)
Regulatory intervention options	Specific ENM production & use	General plastic production & use
Detection in the environment and biota	Challenging - but possible for ENMs made of non-ubiquitous elements	More challenging!

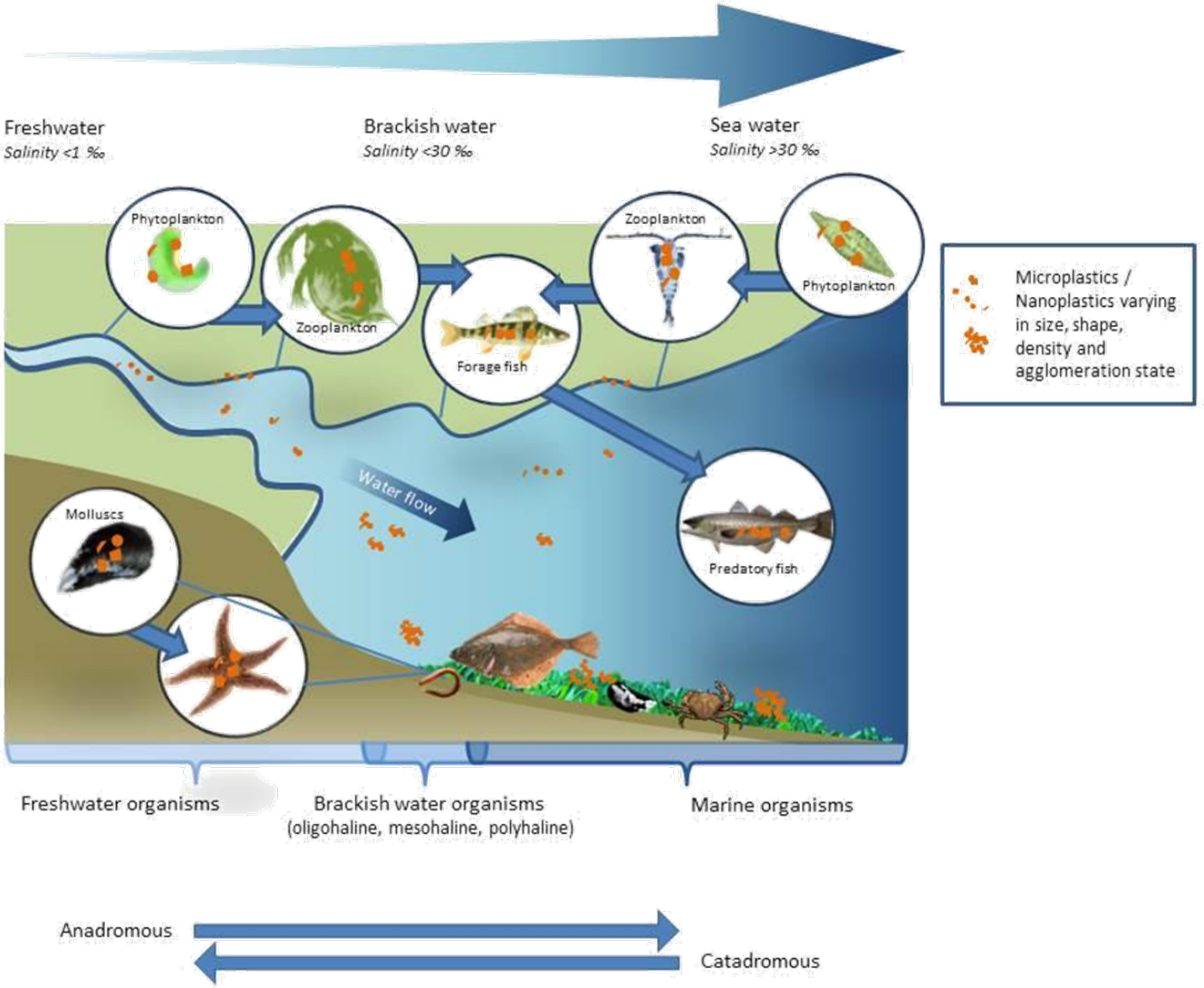
Similarities and differences

	Engineered nanomaterials (ENMs)	Nanoplastics (and microplastics)
Hazardous properties	Can be designed to have a specific biological effects or functionalities	Not intentionally hazardous
Toxic effects potentially caused by…	- Leaching (ions) - Physical interactions - ENM reactivity - Carrier effects	- Leaching (additives) - Physical interactions - Carrier effects
Novel properties as nano	Inert → Reactive	???

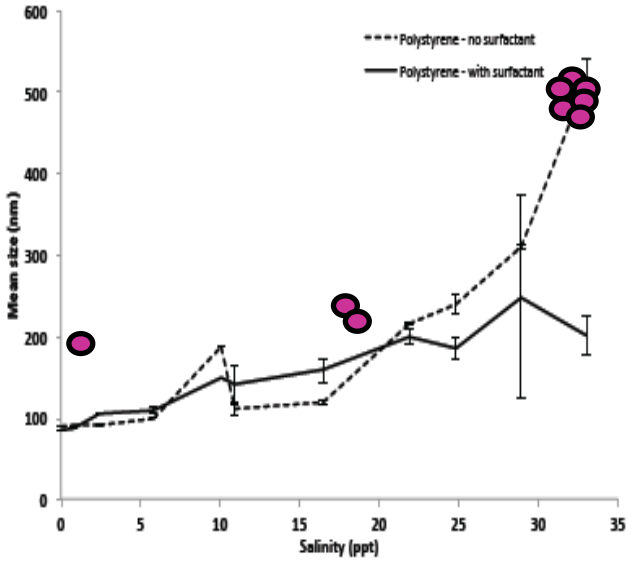
Nanoplastics – an environmental problem?

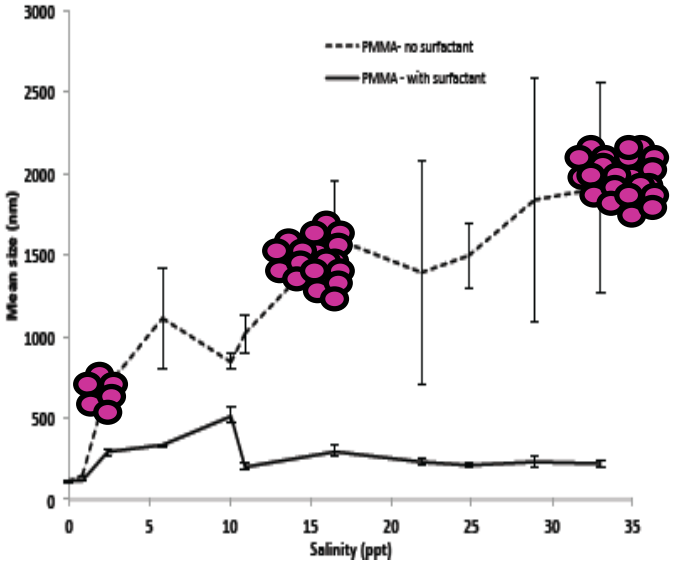


Will nano stay nano?



Probably not…



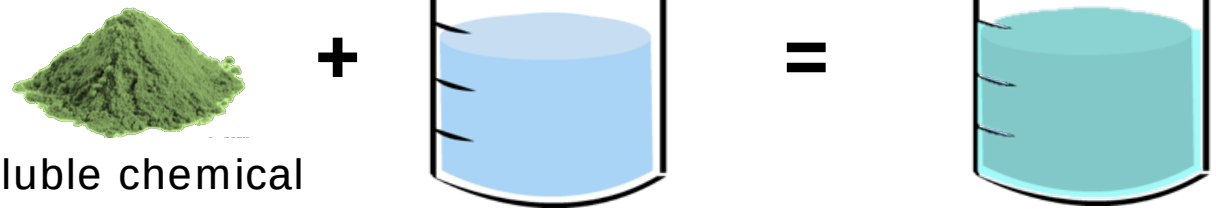


Polystyrene

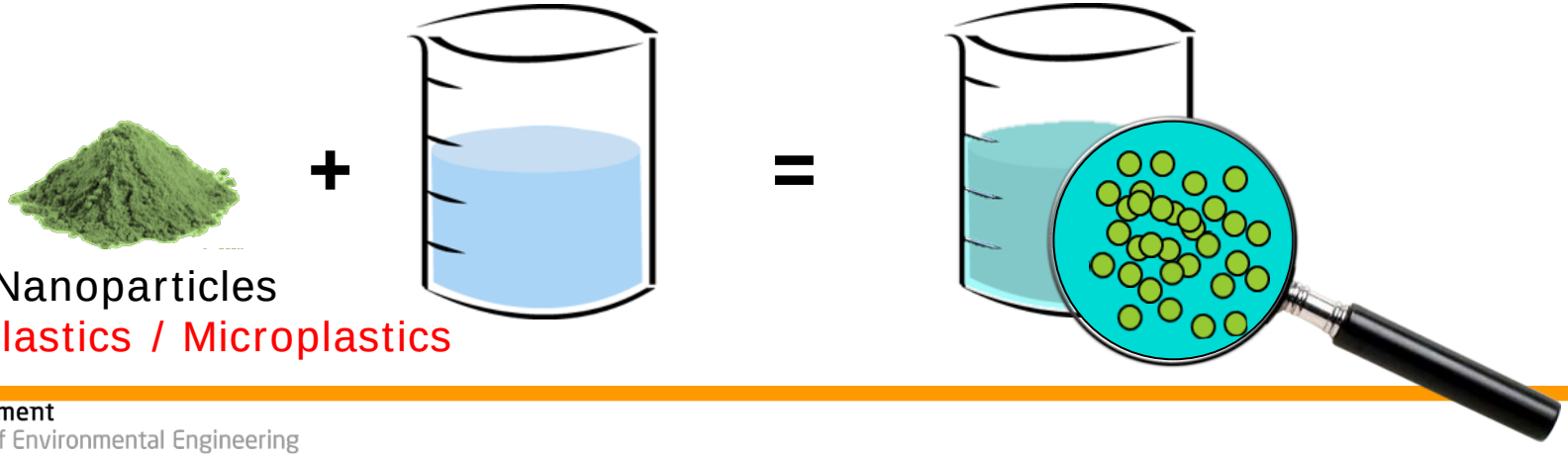
PMMA

+ interactions with organic matter, phytoplankton etc.

Water soluble chemicals VS. particles



Soluble chemical

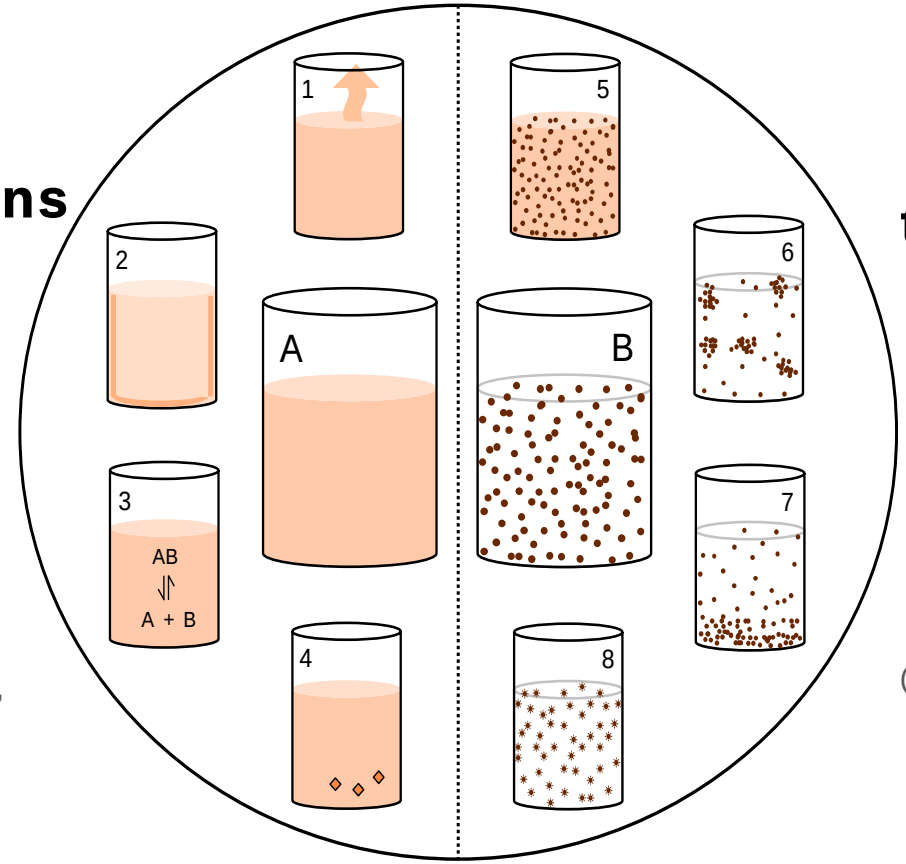


Nanoparticles

+ Nanoplastics / Microplastics

Water soluble chemicals VS. particles

Chemical and physical transformations and reactions



Mainly physical transformations

Dissolution, Evaporation, Precipitation, Speciation / Complexation / Dissociation, Sorption as sorbant

Dispersion. Release of ions, (De)agglomeration/ (de)aggregation, Sedimentation, Surface transformations and in situ functionalisation, Sorption as sorbant/sorbent

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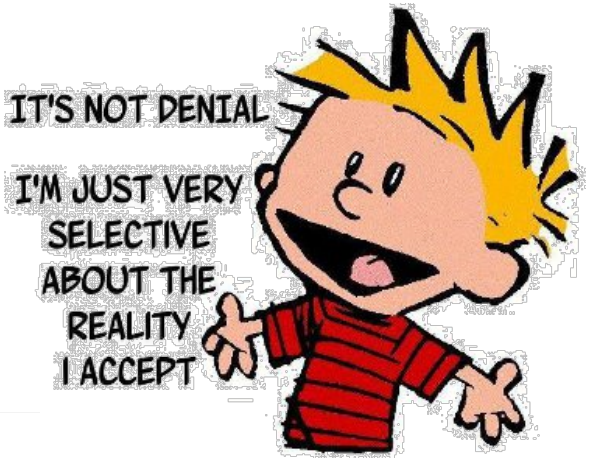
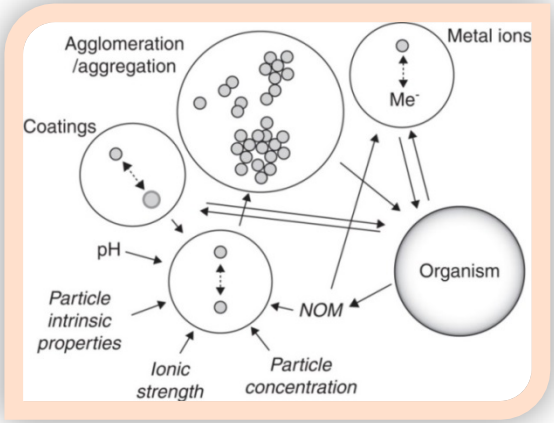
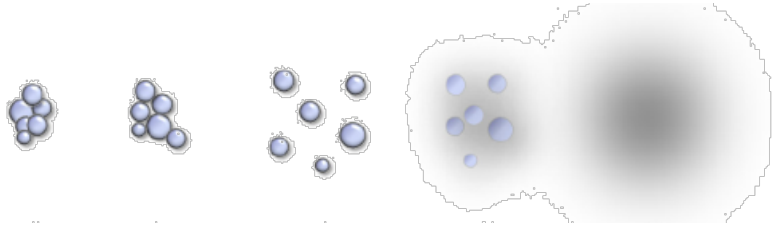
Skjolding et al., 2016 (*under review*)

1st step: acknowledging the problem





Effect = f(conc)

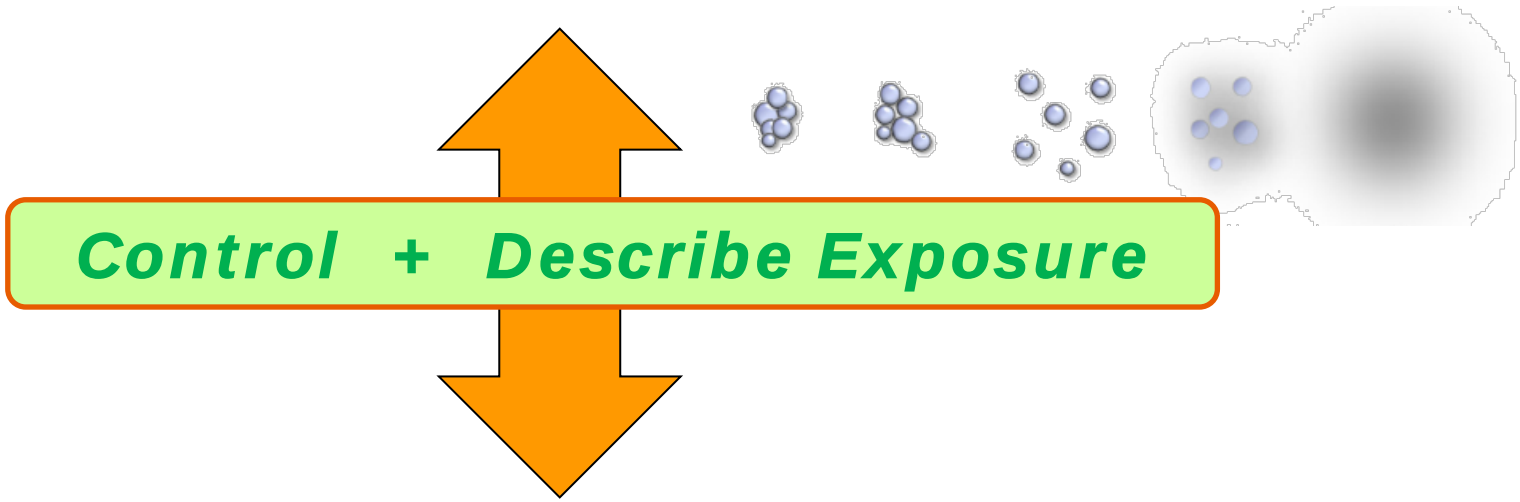


Effect = f(conc.,time, organism, media etc)

Baalousha & Lead (2013). Nature Nanotechnology, 8, 308-309
Baun, et al. (2008).. Ecotoxicology, 17 (5), 387-395
Hartmann et al.. (2013)..Nanotoxicology DOI: 10.3109/17435390.2012.710657

The ‘solution’…

Effect = f(conc.,time, organism, media etc.)



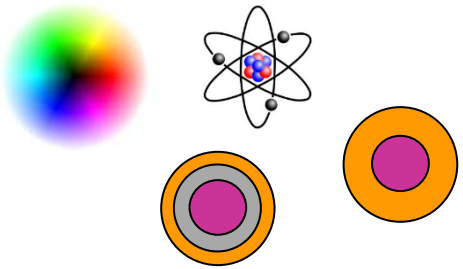
INTERPRETATION OF TEST RESULTS

Ecotioxicity testing of nanoplastics – key challenges and suggestions

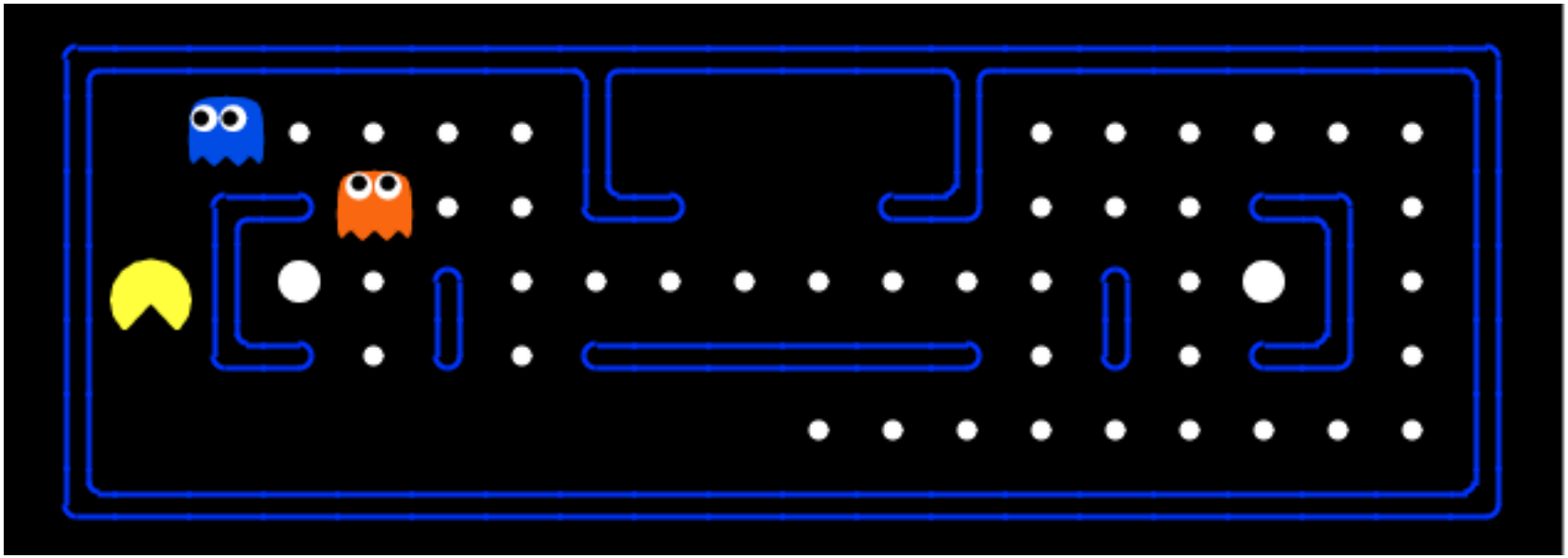
- Making our studies (more) relevant:
  - What we test VS nanoplastics in the environment
  - Properties of environmentally weathered nanoplastics?
  - In lack of environmental nanoplastic samples → more studies on artificial weathering are needed!

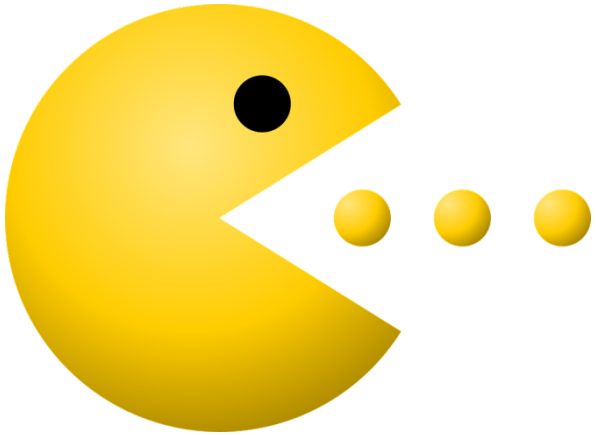
- Detection, identification and quantification in the environment
  - Need for standardised methods → increased comparability
  - Increased analytical sensitivity (size & concentration)

- Detection and quantification in lab experiments



Lessons learned from microplastic research





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